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ABERRANT CONES IN WESTERN WHITE PINE

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ABSTRACT

Two rare cone forms--proliferated and forked--are reported and illustrated for Pinus monticola. The latter form may be unique to this species, and may be genetically controlled. In addition, genes controlling the "forked-cone" trait may be linked with recessive genes associated with chlorophyll deficiencies of P. monticola foliage.

We have found two rare cone forms in western white pine (Pinus monticola Dougl.). These aberrant forms were found among the more than 70,000 female cones observed on over 1,500 trees, in the course of our 18 years of research into the nature of blister rust resistance in that pine species.

The first of these forms (fig. 1)--the so-called proliferated cone--has long been known for a variety of conifers. Doak (1935) listed 11 references wherein the authors mentioned 12 or more conifer species (including Pinus spp.) found to have various modifications of this cone form. Chamberlain (1935, fig. 299) illustrated proliferated cones of Larix and Cryptomeria, as did Looney and Duffield (1958, fig. 1) for Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco).

Occurrence of proliferated cones in two other species has been verified by two other members of our staff: in tamarack (Larix laricina (Du Roi) K. Koch) by G. E. Rehfeldt, and in black spruce (Picea mariana (Mill.) B.S.P.) by D. O. Coffen. In addition, LeRoy Johnson of the Institute of Forest Genetics, Placerville, California,² has sent us a proliferated cone of Aleppo pine (Pinus halepensis Mill.). Probably proliferated cones remain unreported for many other conifers.

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Figure 1.--Proliferated
cone of western
white pine.



Despite the fact that proliferated cones are known for so many conifers, their occurrence remains a rarity. For instance, in 25- to 70-year-old western white pine observed closely for periods of from 5 to 18 years, we have found them on only three or four out of 500 trees. They seem to occur with about the same frequency on 8- to 16-year-old trees (on seven out of 1,000 trees) growing in a Moscow, Idaho, arboretum.

The second aberrant form--forked cones (fig. 2)--may be heritable. While we have found forked cones on only eight western white pines, two of these trees have borne forked cones in successive years. Furthermore, the only two trees in the arboretum at Moscow that have borne forked cones are very closely related; they are full-sibs coming from a controlled cross pollination.

Perhaps even more intriguing is our observation that in western white pine gene(s) controlling the forked-cone trait may be linked with those controlling pigmentation of the foliage. Four of the eight trees known to carry the forked-cone trait have been self-pollinated, and the two arboretum full-sibs known to carry the trait have been crossed. Progenies from the four selfings contained clearly defined 3:1 ratios of green:albino or yellow-green types. And the smaller progeny from the full-sib mating contained a somewhat less clearly defined 3:1 ratio of green:yellow-green types (28:8).

We have also considered the relationship of fasciation and forking of cones. This was because the forking of fasciated conifer shoots seems to be a fairly common occurrence (cf. fig. 13 in Hubert 1931; and fig. 1 in Duffield and Wheat 1963). In fact, Dr. Duffield has directed our attention to a ponderosa pine (*P. ponderosa* Laws., no. P-Eld-4A-22, growing on the grounds of the Institute of Forest Genetics at Placerville) that consistently, year after year, produces fasciated and apparently forked, male cones. E. J. Carpender and C. W. Busche of that Institute kindly have sent us dried male cones from this remarkable tree.

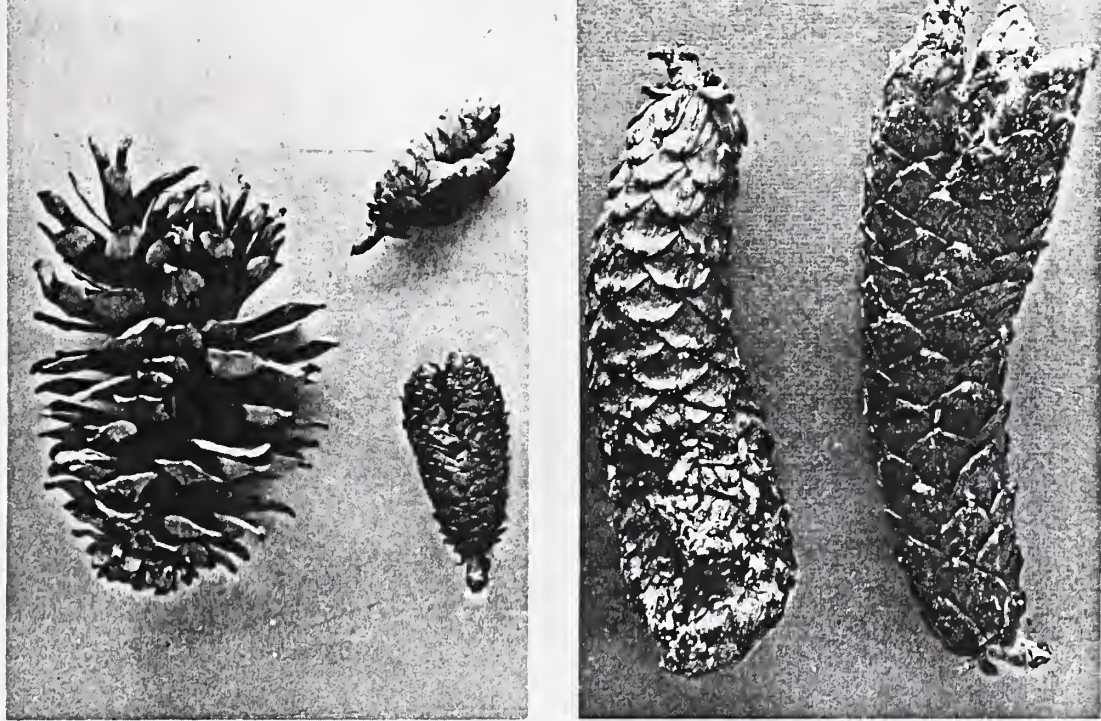


Figure 2.--Double- and triple-forked cones of western white pine.

Outwardly, these male strobili appear to be frequently and conspicuously forked (upper half of fig. 3). But when the microsporangia are removed it becomes apparent that the fasciated cone axes, rather than forking, merely have separated or split apart (lower half of fig. 3). Certain of the fasciated axes have remained intact (fig. 3A); others have partly separated, apparently along lateral fracture lines first developing in the middle portion of the axis (fig. 3C); and still others have split longitudinally, one or more times, separating along their entire length (fig. 3B and D). Mechanical splitting rather than true forking seems to be the case, since sterile surfaces are visible along the lateral fracture lines (lower half of fig. 3B, C, and D).

Close examination of our forked *P. monticola* female cones, however, fails to disclose any fasciation or splitting of the axes. Distad of the forks the cone axes are normal and fertile on all sides.

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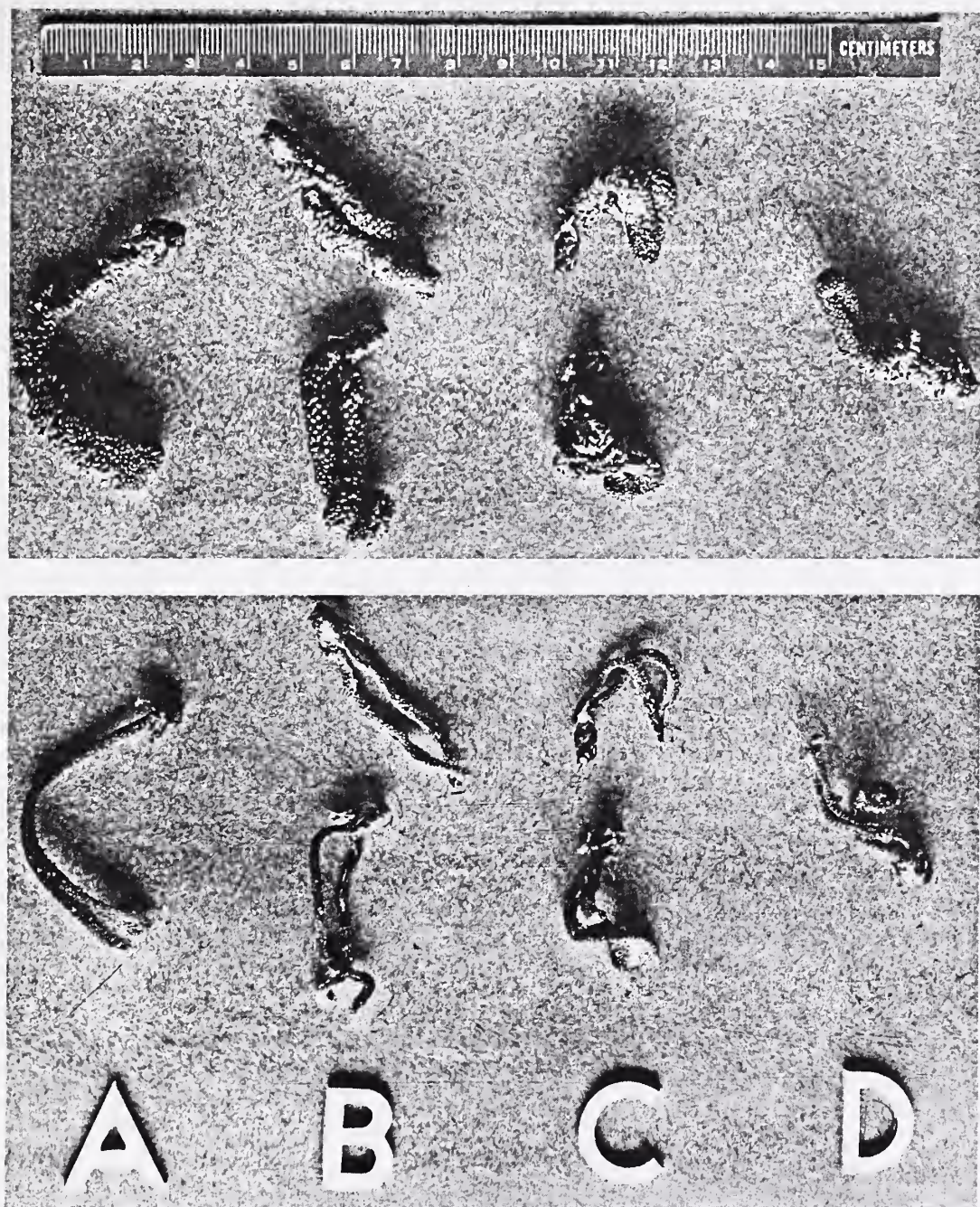


Figure 3.--Fasciated male strobili of ponderosa pine, below with the microsporangia removed.

